Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High Human Development Index Countries

Original Research

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Children physical activity, sedentary behavior, international comparison, Report Card, Global Matrix

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Abstract

Background

To better understand the childhood physical inactivity crisis, Report Cards on physical activity of children and youth were prepared concurrently in 30 very high HDI countries. The aim of this article was to present, describe, and compare the findings from these Report Cards.

Methods

The Report Cards were developed using a harmonized process for data gathering, assessing, and assigning grades to ten common physical activity indicators. Descriptive statistics were calculated after converting letter grades to interval variables, and correlational analyses between the ten common indicators were performed using Spearman's rank correlation coefficients.

Results

A matrix of 300 grades was obtained with substantial variations within and between countries. Low grades were observed for behavioral indicators, and higher grades were observed for sources of influence indicators, indicating a disconnect between supports and desired behaviors.

Conclusion

This analysis summarizes the level and context of the physical activity of children and youth among very high HDI countries, and provides additional evidence that the situation regarding physical activity in children and youth is very concerning. Unless a major shift to a more active lifestyle happens soon, a high rate of non-communicable diseases can be anticipated when this generation of children reaches adulthood.

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Introduction

A compelling body of empirical work shows moderate to high levels of physical activity to be associated with a lower risk of cardiovascular disease and all-cause mortality among adults.[1] Conversely, physical inactivity has been recognized by some as "the biggest public health problem of the 21st century".[2,3] Among school-aged children and adolescents, meeting physical activity guidelines is associated with positive physical, psychological, social, and cognitive health indicators[4,5] while physical inactivity, defined as not meeting physical activity guidelines, is associated with adverse physical, mental, social and cognitive health outcomes.[4–7]

The Human Development Index (HDI) is a composite index, ranging from zero to one, calculated using education, life expectancy, and per capita income.[8] This index was created by the United Nations Development Programme to rank countries on a scale of human development conceptualized in terms of capabilities of humans within the countries to function.[9] To be classified as very high HDI, the score of a country must be equal or superior to 0.80. Among children living in countries categorized as being very high by the HDI, moderate-to-vigorous intensity physical activity (MVPA) was positively related to markers of cardiovascular health[10–13] and self-reported health-related quality of life.[14] Physical inactivity has been estimated to be responsible for at least 10% and 9% of all-cause mortality in North-American and in European countries, respectively.[15] Furthermore, very high-income countries bear the largest proportion of economic burden of physical inactivity worldwide (81% of health-care costs and 60% of indirect costs).[16] However, the majority of children[17–21] and youth[19–25] do not meet the current recommendations of 60 minutes of MVPA per day[26] in very high HDI European and North American countries and regions. Similar findings were observed among children and/or adolescents from other very high HDI countries or regions such as Australia,[27] Chile,[28] Chinese Taipei (Taiwan),[29] Hong Kong, [30] Japan,[31] South Korea,[32] Qatar,[33] and United Arab Emirates.[33–35] Very high HDI countries share similar characteristics in terms of education, life expectancy and income; however, differences also exist

geographically, politically, culturally, religiously, and environmentally that may influence physical activity behavior differently across the very high HDI countries. Cooper et al.[36] found that there was substantial between-country variation in objectively measured MVPA in the International Children's Accelerometry Database, even between apparently similar countries, and concluded that further research is needed to explore environmental and sociocultural explanations for these differences.

To develop a better understanding of childhood physical activity and inactivity across countries, the first Global Matrix (Global Matrix 1.0) of Report Card grades on physical activity was launched in 2014.[37] Report Cards, based on the Canadian Report Card model,[38] were developed by research teams from 15 countries (including eight very high HDI countries) using a harmonized process for data gathering, assessing, and assigning grades.[37] For each participating country, grades were assigned to nine common physical activity indicators: Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behaviors, Family and Peers, School, Community and the Built Environment, and Government Strategies and Investments. Global Matrix 1.0 grades provided new information upon which researchers, advocates, practitioners, and policy-makers could reflect and derive inspiration for children's physical activity research projects and promotion activities around the world.[37]

Building on the Global Matrix 1.0, investigators from each participating country committed to repeat and further develop the Global Matrix initiative along with teams of researchers from 23 new countries. The Global Matrix 2.0, which was released in 2016 in Bangkok, presented a comprehensive summary of the physical activity behaviors and sources of influence indicators from 38 countries (including 24 very high HDI countries).[39] Findings suggested the presence of a complex variety of strengths and limitations across the participating countries, with some universal patterns emerging when comparing countries by continent, HDI, or income inequality. For example, a strong positive correlation was found between the

source of influence grades (combining the grades from Family and Peers, School, Community and the Built Environment, and Government Strategies and Investments) and HDI.[39]

In 2017, the Active Healthy Kids Global Alliance[40] (AHKGA) called for more countries to participate in the Global Matrix 3.0. Forty-nine countries registered and followed the harmonized steps to develop their country's Report Card. Out of the 49 participating countries, 30 (61%)were very high HDI countries, from five different continents: Asia (n = 6), Europe (n = 19), North America (n = 2), Oceania (n = 2) and South America (n = 1). The aim of this article is to present, describe, and compare the Report Card grades from the very high HDI countries and regions participating in the Global Matrix 3.0: Australia, Belgium (Flanders), Canada, Chile, Chinese Taipei (Taiwan), Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Guernsey, Hong Kong, Japan, Jersey, Lithuania, Netherlands, New Zealand, Poland, Portugal, Qatar, Scotland, Slovenia, South Korea, Spain, Sweden, United Arab Emirates, United States, and Wales. Companion papers published in this issue of the *Journal of Physical Activity and Health* present the collective results from the low and medium HDI countries, and the high HDI countries.

Methods

The AHKGA distributed an open call through established networks for interested countries and opened registration for the Global Matrix 3.0 in April, 2017. As a result, 49 countries from five different continents fully participated in the Global Matrix 3.0. Workgroups consisting of experts and stakeholders were established in each country to gather the highest quality and most recently published and unpublished evidence. The workgroups critically appraised the available evidence and reported on 10 common indicators (Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, Sedentary Behaviors, Physical Fitness, Family and Peers, School, Community and the Built Environment, and Government) for school-aged children and youth (~5-17 years-old). Through

a harmonized and transparent Report Card development process, each country's workgroup compiled the available evidence from local, national or international studies, national surveys and official reports, and then synthesized findings and reached consensus for the grading of each indicator. Full details of the Report Card development process based on the Canadian Report Card model[38] have been previously described and the detailed methods for the Global Matrix 3.0 are described in a companion paper published in this issue of the *Journal of Physical Activity and Health*.[41]

For each of the 49 registered countries, up to three joint Report Card leaders were charged with forming a multidisciplinary research workgroup (including physical activity experts, stakeholder groups, and communication specialists) to manage the Report Card project, and to ensure the effective communication between AHKGA and the Report Card team. The workgroups identified and finalized the list of indicators to be graded (i.e., the ten common indicators and potential additional ones that would be included in their national Report Card but not in the Global Matrix 3.0), and compiled potentially relevant datasets and documents that would be used to inform the grades. Countries were advised to consider and synthesize the best available evidence from approximately the past five years for each indicator. Common benchmarks, presented in Table 1, and a common grading scheme, shown in Table 2, were provided by the AHKGA to the 49 Report Card workgroups. Experts in each country evaluated the compiled evidence and reached consensus on the grade assigned for each indicator. Draft country Report Card grades were submitted along with their rationale and were audited by the members of the AHKGA Executive Committee to ensure that the grades were consistent with the harmonized benchmarks and grading scheme. The Report Card leaders were also asked to report details concerning the datasets used to inform their overall physical activity grade (i.e., subjective or objective measures, representativeness, instrument used, age range, and sample size).

For analysis purposes, the 49 participating countries and regions were divided into three categories using the United Nations' HDI groupings (low or medium, high, and very high). The results and analyses presented in this article are on the 30 very high HDI participating countries.

Descriptive statistics (average grade and standard deviation) were calculated after converting categorical variables (letter grades) to interval variables (see corresponding numbers in Table 2), and the incomplete grades (INC) converted into "No Grade" which was treated as a missing value. Averages were calculated from the interval values and the floor (for a given value, the greatest integer less than or equal to the average value) was converted back to a letter grade. Three scores were computed for analysis: 1) Overall score, 2) Behavioral score (Overall Physical Activity, Organized Sport and Physical Activity Participation, Active Play, Active Transportation, and Sedentary Behaviors), and 3) Sources of influence score (Family and Peers, School, Community and the Built Environment, and Government). Scores for each group of indicators were calculated by summing the relevant interval data. INC grades were removed and the scores were re-weighted accordingly. Categorical variables (letter grades) were grouped into one of four levels ("A-B", "C", "D-F", and "No grade") based on the overall score. These categories were then used to rank countries by letter grade/score and category level in scatter plot data visualizations. Correlational analyses between the ten common indicators were performed using Spearman's rank correlation coefficients. Pairwise deletion was used to treat missing data (incomplete grades) instead of other techniques (e.g., list-wise deletion) in order to minimize the number of cases excluded from the analysis. All statistical analyses were performed using R version 3.4.1 (The R Foundation for Statistical Computing, Vienna, Austria). Several packages were loaded to extend base R including corrplot,[42] ggplot2,[43] UpSetR,[44] and VIM.[45] In addition, descriptive statistics of the qualitative information regarding the measurement of overall physical activity were performed.

Results

The sociodemographic characteristics of the 30 very high HDI countries are presented in Table 3. The HDI scores ranged from 0.840 for United Arab Emirates to 0.939 for Australia. Chile was the country with the lowest Gross National Income per capita, the highest Gini Index (highest income inequality), and the highest child poverty rate (0.225). Qatar had the highest Gross National Income per capita, the lowest

relative public health expenditure and the highest Gender Inequality Index. Slovenia had the lowest Gini Index (least income inequality) and the lowest percentage of urban population (49.8%). The life expectancy at birth was above 80 years for most of the countries (23 countries, 77%), with a maximum of 84.2 years for Hong Kong. Lithuania had a notably lower life expectancy of 73.5 years compared to other countries. The mean years of schooling ranged from 8.9 years in Portugal to 13.3 years in the United Kingdom nations (England, Scotland, and Wales). Finally, population density ranged from 3.2 people/km^2 of land area for Australia, to 6987.2 people/km^2 of land area for Hong Kong. In summary, despite all 30 countries being within the very high HDI category, countries varied substantially in other characteristics.

The 30 country grades for the 10 core Report Card indicators (300 grades or INC in total) and the average grades for each country are shown in Table 4, and the corresponding descriptive information are presented in Table 5. In total, 233 letter grades and 67 INC grades were assigned (Table 4). The country with the highest average grade was Slovenia with "B", and the countries with the lowest average grade were Chile and the United States with "D". All 30 countries assigned a grade to Sedentary Behaviors, 29 countries (97%) to Overall Physical Activity, and 28 countries (93%) to Organized Sport and Physical Activity and to Active Transportation. Active Play was the indicator with the largest number of INC grades (n = 20), followed by Physical Fitness (n = 13), and Family and Peers (n = 13). The indicator with the highest average grade was Community and the Built Environment with "B-", while the indicator with the lowest average grade was Overall Physical Activity with "D-". An average grade of "D+" was obtained for the behavioral indicators combined, "C+" for the source of influence indicators combined, and "C-" was the overall average for the 233 grades. Qatar's Report Card workgroup decided not to evaluate Active Transportation and considered it "not applicable (N/A)" because of unsafe road conditions and the hot climate during most times of the year.[46] Correlation analyses showed that there were no relationships between the Overall Physical Activity grade and any of the other nine core indicator grade (results not shown). Frequency plots illustrating the distribution of the overall 233 grades as well as

the behavioral and the sources of influence indicators are presented in Figure 1A and Figure 1B, respectively. A normal distribution of the letter grades is evident in both Figures 1A and 1B, with the mode being "C" for the 233 letter grades overall, "D" for the behavioral indicators, and "B" for the sources of influence indicators.

A plot for the overall score for each country estimated from the 10 indicators is presented in Figure 2, and the behavioral and the source of influence scores in Figure 3 and Figure 4, respectively. For the overall score, Slovenia ranked first while Chile ranked 30th (see more rankings in Figure 2). In terms of the grading completion, the United Arab Emirates had only four graded indicators that were included in the calculation of this score while four other countries (Slovenia, Finland, Czech Republic and Canada) had all 10 indicators graded. For the behavioral score, Japan ranked first while Estonia ranked 30th (see more rankings in Figure 3). The United Arab Emirates had only two out of five indicators, and Japan and Qatar only had three graded indicators that were included in the calculation of the behavioral score. Similar to the overall score, Slovenia also ranked first for the sources of influence score while Guernsey, with only one out of four graded indicators available, ranked 30th (see more rankings in Figure 4).

Finally, the description of the data sources used to inform the Overall Physical Activity grade for each country (except for Japan that had an INC) are presented in Supplemental File 1. In total, 87 surveys or studies informed the grades of the very high HDI countries, representing a total sample size of 1,005,989 children and youth. A total of 21 surveys/studies used an objective measurement of physical activity while 66 used a subjective method, mostly via self-administered questionnaires. Out of 21 surveys/studies that measured physical activity objectively, 20 used accelerometry and one study used pedometry. A minimum wear time for accelerometer ranged between 3 to 7 consecutive days, and nine different accelerometer cut-points were applied for analysis across 20 surveys/studies with the most commonly used cut-points (n = 8) from Evenson et al.[47] Regarding the subjective measurement of physical activity, survey-specific questionnaires were used in a significant number of surveys (n = 35), followed by original or adapted versions of the *Health Behaviour in School-Aged Children* questionnaire (n = 14), uniquely in

European countries), the *Global School-based Student Health Survey* questionnaire (n = 5), the *Youth Risk Behavior Surveillance System* questionnaire (n = 4), the *International Physical Activity Questionnaire* (n=3), and others (n=5).

Discussion

The objective of this paper was to present, describe, and compare the Report Card grades from the 30 very high HDI countries and nations participating in the Global Matrix 3.0. A wide range of grades was observed for most indicators across countries. These 30 countries are geographically distributed across Asia, Europe, North America, Oceania, and South America and have very different climatic, geographic, demographic, and cultural characteristics. Despite these contextual differences, most of these countries shared concerning low grades for Overall Physical Activity and Sedentary Behaviors. No country was consistently leading nor falling behind the others across the 10 common indicators, however some countries showed greater or less success than others. The characteristics of the most and the least successful countries are discussed below, followed by a discussion of the findings for each indicator, and an integrated discussion of the findings including the strengths and limitations of this study.

Most successful countries

Slovenia had sufficient data to inform the 10 indicators and obtained the best grades for Overall Physical Activity ("A-"), Family and Peers ("B+"), and Government ("A"), as well as on average ("B"); and shared the best grades for Sedentary Behaviors with Spain ("B+"), and for School ("A") with Finland and Portugal. A notable feature of Slovenia is the importance of sport for the culture of this almost 30-year old country as "Slovenes tend to view sports as an effective tool in fostering national identity among citizens and making successful global identity claims".[48] Every April since 1987, a national school-based surveillance system of physical fitness (named *Slofit*) takes place, targeting the majority of Slovenian

school children and youth aged 6 to 19 years.[49] Negative trends in motor skills and physical fitness were observed for over two decades in Slovenia, but since 2011, these trends has been reversed after the implementation of a health-oriented physical activity intervention program, which offers children two (optional) additional hours of physical activity per week.[50] The estimated proportion of Slovenian children and youth meeting the recommended levels of daily physical activity is now high (over 80%), and this encouraging outcome seems to be the result of the collective support for childhood physical activity from the government, the educational system, and the parents themselves.[51]

The next two most successful countries were Denmark and Japan with an average grade of "B-". The positive result for these two countries should be interpreted with caution as both had "INC" grades for some indicators. Active Play, Physical Fitness, and Family and Peers for Denmark, and Overall Physical Activity and Active Play for Japan were not graded due to the lack of data. Nonetheless, Denmark was the country with the best grade for Organized Sport and Physical Activity ("A-"), and also obtained a grade of "A-" for both School and Government indicators. Sport is an important part of the Danish culture, and considered important not only for individual and population health, but also in relation to issues such as social inclusion and community cohesion.[52] Despite Denmark performing rather well on the strategic and political levels, low grades were attributed to Overall Physical Activity ("D-") and Sedentary Behaviors ("D+"), indicating an implementation gap between the governmental and individual levels.[53]

Japan had the best grades for Active Transportation ("A-") and Physical Fitness ("A"), and had no grades lower than "C-". In fact, Japan has a highly established "walking to school practice" that has been implemented since the School Education Act enforcement order, enacted in 1953, stating that public elementary schools should be sited within no more than 4 kilometers, and for public junior high schools no more than 6 kilometers from the student's home. This policy is still successful today at promoting active transportation among Japanese children and youth.[54] The Physical Fitness grade was assigned based on the performance of Japanese children and youth on the 20-meter shuttle run test. On average, Japanese children were in the 90th percentile,[55] based on age- and sex-specific international normative

data.[56] The Organized Sport and Physical Activity participation (graded "B-") and the favorable School environment (graded "B+") may explain this high level of physical fitness; however, this is speculative and more research is necessary. It was observed that only a minority of time in physical education classes was spent in MVPA (27.3%/45 min/class) in Japanese primary school students.[57]

Least successful countries

Chile and the United States were the two countries with the lowest average grade: "D". They were followed by Guernsey, Jersey, Scotland, South Korea, United Arab Emirates, and Wales, who obtained an average grade of "D+". Chile had the lowest grades for Active Transportation ("F"), Family and Peers ("F"), and shared the lowest grades for Organized Sport and Physical Activity with Taiwan ("D-"), and for Physical Fitness with Canada, Hong Kong and Jersey ("D"). In Chile's first Report Card (2016), all indicators had low grades, and data from different surveys indicated that there were consistent disparities across genders, socioeconomic status, and school types.[58] In 2018, Chile's grades remained low in comparison with the first Report Card in 2016 but progress was made on environmental and policy aspects,[59] raising hope that these improvements will positively affect behavioral indicators in the future.

The low average grade of the United States should be interpreted carefully because three indicators were assigned an "INC" grade: Active Play, Family and Peers, and Government. The United States shared the lowest grades with the United Arab Emirates for School ("D-"), and the Community and the Built Environment ("C") with England, Jersey, Lithuania, and Poland. Overall, none of the indicators were graded above "C" in the United States. This is the third Report Card for the United States, and the grade for Overall Physical Activity ("D-") remained consistent with the 2014 and 2016 Report Card.[60,61] Similarly to Chile, major disparities in physical activity participation across gender, race/ethnicity, age, and socioeconomic status were observed.[62]

Overall Physical Activity

Among the 30 very high HDI countries, only Japan assigned an "INC" grade for Overall Physical Activity. The grades ranged from "F" to "A-" for this indicator; however Slovenia was the only country with a "good" grade ("A-"), and all the other countrys' grades fell between "F" and "C". Five countries received an "F" (Flanders, Scotland, South Korea, Taiwan, and the United Arab Emirates), four countries assigned "C" grades (England, Hong Kong, Lithuania, and Netherlands), and all the remaining countries had a "D-", "D", or "D+". The comparison and interpretation of the Overall Physical Activity grades should be conducted carefully given the important variation in the methods used to measure Overall Physical Activity between the countries, as seen in Supplemental File 1. In fact, objective data were used in 13 of 29 countries with an Overall Physical Activity letter grade, and subjective data in 27 countries (11 countries combined subjective and objective data to inform their Overall Physical Activity indicator). In addition, even among the subjective or the objective data, the methods differed largely in terms of instruments, analysis, age range, sample size, and representativeness of samples.

The correlational analyses showed that there was no relationship between Overall Physical Activity, and the physical activity related indicators (Organized Sport and Physical Activity, Active Play, and Active Transportation). For example, only 56% of children and 33% of adolescents met the international physical activity recommendations in the Netherlands despite a high level of Organized Sport and Physical Activity, Active Play, and Active Transportation (graded "B", "B", and "B-", respectively).[63] A similar pattern was observed in Belgium (Flanders), Denmark, Scotland, South Korea and Spain where Overall Physical Activity was graded "F" or "D/D-" despite the fact that grades between "A" and "C" were assigned to Organized Sport and Physical Activity, Active Play, and Active Transportation (note: an "INC" grade was assigned to Active Play for Flanders, Denmark, Scotland, and South Korea).[53,64–67] The opposite situation was observed in Slovenia where Overall Physical Activity was graded "A-", while Organized Sport and Physical Activity, Active Play and Active Transportation were graded "C+", "D", and "C", respectively.

The absence of a relationship between Overall Physical Activity and other behavioral indicators can potentially be explained by the aforementioned differences in methods used to measure these indicators and the diversity of benchmarks between countries. The recommended benchmark for physical activity was "% of children and youth […] who accumulate at least 60 minutes MVPA per day on average, or % of children and youth meeting the guidelines on at least four days a week (when an average cannot be estimated)" (Table 1). The available data in each country did not necessarily allow them to use either of these benchmarks strictly when estimating the prevalence of physically active children and youth in their sample. For example, in France, a "high level of physical activity" corresponded to engage in physical activity five or more days a week, and the regular use of active transportation, for 6-10 year olds (reported by the parents); and practicing a MVPA at least five days a week for 11-17 year olds (self-reported).[68] While in England's 2018 Report Card, the percentage of children and youth accumulating at least one hour of MVPA seven days a week was evaluated.[69] In addition, among the countries where objective methods were used to measure physical activity, the estimated number of children meeting the physical activity guidelines could also have been significantly affected by the cut-off point that defines the count per minute threshold for MVPA.[70] Although the majority of studies included in Global Matrix 3.0 used the Evenson cut-off point,[47] several studies used different ones. For example, the Freedson cut-off point[71] was used in Hong-Kong, while the Puyau cut-off point[72] was used in Canada (Supplemental File 1).

Notwithstanding the presented methodological issues across countries, 29 out of 30 very high HDI countries assigned a letter grade to the Overall Physical Activity indicator, and for 28 of them, this grade was between "C" and "F", with an average of "D-". These results are consistent with the current literature. A systematic review of physical activity in European children and adolescents found that 5%-47% of children and adolescents when measured subjectively, or 0%-60% of children and adolescents when measured objectively, achieved the recommended levels of physical activity.[73] In another study describing objectively-measured physical activity and sedentary time patterns in children and youth in 10 countries (nine very high HDI countries and Brazil), only 9% of boys and 2% of girls accumulated ≥60

minutes of MVPA on all measured days.[36] The present study provides additional evidence that the situation regarding the physical activity of children and youth is very concerning in very high HDI countries, and public investment to implement effective interventions for increasing physical activity opportunities are needed urgently. Unless a major shift to a more active lifestyle happens soon, a high rate of premature non-communicable diseases can be anticipated when this generation of children will reach adulthood.

Organized Sport and Physical Activity

Most of the countries assigned a letter grade to Organized Sport and Physical Activity, excepting Jersey and the United Arab Emirates. With an average grade of "C+", Organized Sport and Physical Activity was the most successful behavioral indicator in the very high HDI countries. Only three countries had a low grade for this indicator: Chile ("D-"), Taiwan ("D-"), and France ("C-"); while 12 countries had relatively higher grades ("B+", "B", "B-") behind the lead of Denmark ("A-"). In Canada, Organized Sport and Physical Activity was the only behavioural indicator with a high grade ("B+"),[74] in which the high participation rate (77%) has been relatively stable since 2005.[75] Similarly, Organized Sport and Physical Activity was also the highest graded indicator in Sweden.[76] In relation to its geographical and population size, Sweden is considered as one of the world's most sporting nations: out of the seven million inhabitants between the ages of 7 and 70, more than three million were active members of sport clubs and more than two million were competing regularly in 2012.[77] However, as presented before, these high rates of sport participation were not associated with a sufficient level of physical activity in the population.

Given that the benchmark for Organized Sport and Physical Activity ("% of children and youth who participate in organized sport and/or physical activity programs") does not specify intensity, duration, or frequency, we are missing important contextual information of this indicator. These characteristics should

be evaluated to estimate the dose of physical activity associated with sport participation among children and youth. However, the popularity of sport among children and youth from very high HDI countries suggests that increasing organized sport opportunities and accessibility could be a strategic solution to address the prevalence of childhood physical inactivity in these countries. Further research focusing on this indicator is needed to evaluate if the available organized physical activity opportunities are indeed saturated. Moreover, are all countries providing free or affordable and appealing physical activity and sport participation opportunities for the entire youth population including different age, gender, socioeconomic, ethnic, and special population groups (e.g., children with learning and/or physical disabilities)?

Active Play

The main finding concerning Active Play was the amount of missing data: 20 out of the 30 very high HDI countries assigned an "INC" grade to this indicator. Among the 10 countries with a letter grade, the Netherlands attained the highest grade ("B"); Estonia the lowest grade ("F"); and the eight remaining countries had "C"s or "D"s. The average grade of "D+" for this indicator suggests that there is a low level of engagement in this behavior, and/or that researchers were not able to detect it with the measurement instruments they used. Indeed, valid and reliable tools to assess active play is largely limited.[78] In the Czech Republic, Active Play was measured using self-reports of unstructured/unorganized active play for at least two hours per day;[79] while in New Zealand, surveys asked parents/guardians or youth report to indicate if the children or youth had been active while playing (on their own or with others) in the last seven days, if they had been active while playing for at least seven hours in the last seven days, and if they were allowed to go out on their own in the neighborhood.[80] The development of standardized tools for the measurement of Active Play is challenged by the need for consensus on a definition. In a recent systematic review synthesizing the literature to identify key concepts used to define and describe active play among young children, Truelove et al.[78] proposed the following definition: "a form of gross motor or

total body movement in which young children exert energy in a freely chosen, fun, and unstructured manner". But a consensus definition needs to be officially internationally agreed upon and acknowledged to advance the development and acceptance of standardised measurement tools.

Active Transportation

For Active Transportation, the grades ranged from "A-" (Japan) to "F" (Chile), with an average of "C-". Qatar and the United Arab Emirates were the only two countries that did not assign a letter grade to this indicator. Interestingly, three of the four countries from Eastern Asia are leading this indicator: Japan ("A-"), Hong Kong ("B+"), and South Korea ("B+"). The successful school policy that has been identified underlying this high prevalence of active transportation among children and youth in Japan was discussed previously in this paper. In Hong Kong, a high proportion of children using active transportation can be explained by the very high population density of the city: most districts are highly self-contained so children usually attend schools close to their home.[81] Similarly, because most students live within 10-minute walking distance to/from school, national data showed that active commuting is prevalent in South Korea: 79.4% of children and youth reported that they take active modes of transport to/from places.[66] Previous research has shown that active transportation is associated with increased physical activity;[82] however, the Active Transportation indicator was not correlated with Overall Physical Activity among children in very high HDI countries in this study. Similar to Organized Sport and Physical Activity and Active Play, the benchmark for this indicator does not indicate duration or intensity of activity. Therefore, it is not possible to evaluate the extent to which this indicator is contributing to the Overall Physical Activity of children and youth.

Sedentary Behaviors

Sedentary behavior corresponds to any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture.[83] For example, in children and youth, it includes to the use of electronic devices while sitting, reclining or lying, as well as reading, writing, or drawing while sitting.[83] While reading is associated with positive outcomes such as higher academic achievement, screen time, often used as a proxy for sedentary behavior in research, has been shown to be associated with a variety of negative health outcomes among children and youth.[84] For this reason, guidelines focusing specifically on screen time were developed for the first time in Canada in 2011, recommending limiting screen time to two hours daily for the 5-17 year-olds.[85] Consistent with the current guidelines, the benchmark for Sedentary Behaviors was solely based on screen time: "% of children and youth who meet the *Canadian Sedentary Behaviour Guidelines* (5- to 17-year-olds: no more than 2 hours of recreational screen time per day)".

Sedentary Behaviors was the only indicator without any "INC" grades. Estonia, Scotland, and Wales were the three countries with the lowest grade for this indicator ("F"), while Slovenia and Spain had the highest grade ("B+"). The remaining countries all had "C"s or "D"s, and the average for this indicator was "D+". In total, only five out of the 30 very high HDI countries had a grade of "C" or higher. A small methodological difference was observed between the very high HDI as few countries such as Estonia, France, and Sweden reported the percentage of children and youth who had less than two hours (<2 hour/day) of daily screen time, while most of the countries reported those spending two hours or less (≤2 hour/day) in front of a screen. Another potential source of bias was not taking into account the potential multi-tasking use of screens (e.g., using a phone while watching a movie) as it was the case for France, which could have led to an overestimation of screen time.[68] Despite these potential methodological issues, the grades observed for this indicator are extremely concerning among the very high HDI countries. In Estonia, the prevalence of children meeting the screen time recommendation was estimated as low as 7%.[86] The development of more effective interventions targeting the reduction of screen time among children and youth in very high HDI countries should be a public health priority.

Physical Fitness

This is the first time that Physical Fitness has been evaluated in the Global Matrix. Physical fitness corresponds to a state characterized by an ability to perform daily activities with vigor, and a demonstration of traits and capacities that are associated with a lower risk of the premature development of diseases associated with physical inactivity.[87] The health-related components of physical fitness are cardiorespiratory endurance, muscular endurance, muscular strength, body composition, and flexibility.[88] A recent systematic review of the relationship between the 20-meter shuttle run performance and health indicators among children and youth found that performance on this test was associated with favourable indicators of adiposity, and some indicators of cardiometabolic, cognitive, and psychosocial health in boys and girls, and concluded that physical fitness can be used as a holistic indicator of population health in children and youth.[89]

The benchmark for this indicator was the average percentile achieved on certain health-related physical fitness component-based on the normative values published by Tomkinson et al.[56] On average, Physical Fitness was graded "C-". The highest grade was obtained by Japan ("A"), closely followed by Slovenia ("A-"); and four other countries (Canada, Chile, Hong Kong, and Jersey) shared the lowest grade ("D"). An "INC" grade was assigned to Physical Fitness in 13 countries. Various health-related physical fitness components and different normative values were used to calculate the percentile achieved by their sample of children and youth and inform this indicator from one country to another. For example, in Hong Kong this indicator was graded based on peak oxygen consumption, estimated with the performance on the 20-meter shuttle run performance among 9-17 year olds;[90] Jersey had data on cardiorespiratory fitness, muscular strength, muscular endurance, flexibility, and motor fundamental movement skills development for school-aged children.[91] Lithuania had data on endurance, lower body muscular power, upper body muscular endurance, and lower body muscular endurance for 11-18 year olds. Given these significant variations, the comparison of the Physical Fitness indicator between very high HDI countries is

554 compromised and this highlights the need for developing international standardized measurements of
555 health-related physical fitness components.

556

557 *Family and Peers*

558 Similarly to Physical Fitness, 13 countries assigned an "INC" grade to the Family and Peers indicator. On
559 average, this indicator was graded "C-", with Slovenia having the highest grade ("B+") and Chile having
560 the lowest grade ("F"). Parental support and significant others support has been identified as two of the 16
561 correlates that are consistently associated with physical activity of children and/or adolescents in a
562 systematic review of reviews.[92] Because of the complexity of this indicator, several benchmarks were
563 proposed for its evaluation (Table 1), and measurement variations were observed. In Poland, the grade
564 was based on self-report of their parents' (material, emotional) support to their physical activity
565 participation, on self-report of their parents' regular participation in physical activity, and on the
566 prevalence of youth who declared being regularly physically active with their father, their mother, and
567 their siblings.[93] In Germany, the prevalence of parents regularly participating in physical activity and the
568 prevalence of children feeling that they receive positive support from their parents and friends to be
569 physically active informed the Family and Peers indicator.[94] These findings show that there is still a need
570 for an established definition of Family and Peer Influence, and then standardised and validated methods
571 of measurement for the Family and Peers indicator.

572

573 *School*

574 The School indicator had an average of "C+", and only three countries had an "INC" grade for this
575 indicator: Guernsey, Scotland, and Wales. The United Arab Emirates and the United States had the lowest
576 grade ("D"), and Finland and Portugal shared the best grade for School ("A"). A variation in data was
577 used to inform this indicator within the countries. In Finland, 87% of the schools participated in the

national *Finnish Schools on the Move* programme. This programme aims at achieving more pleasant and active schooldays for children and encourages schools to increase physical activity during the school day as well as commuting.[95] In Portugal, physical education classes are mandatory for all students from pre-school to 12th grade. The time allocated to physical education classes ranges from 90 to 150 min/week over two or three sessions/week, and these classes are taught by a certified physical education teacher. In addition, 85% of Portuguese schools offer school clubs under the supervision of a physical education teacher, including competitions within and between schools.[96] The correlational analyses did not find an association between the School and the Overall Physical Activity indicators, but similarly to other indicators, the heterogeneity of data used to inform the School indicator are potentially affecting this relationship.

A review of the relationship between academic performance and participation in school-based physical activities, including physical education, free school-based physical activity, and school sports, found that adding time to academic or curricular subjects by taking time from physical education programmes does not enhance grades in the corresponding academic subjects, and could be detrimental to health.[97] On the contrary, the authors also suggested that more time can be allocated to physical activity from other subjects without the risk of hindering students' academic achievement.[97] These findings suggest that the school environment, policy, and curriculum have the potential to increase physical activity among children and youth, and more specific interventions targeting the creation of daily physical opportunities at school need to be developed in very high HDI countries.

Community and the Built Environment

With an average of "B-", Community and the Built Environment was the highest graded indicator of the 10 core indicators among the 30 very high HDI countries. The lowest grade for this indicator was "C", shared by five countries (England, Jersey, Lithuania, Poland, and the United States), and the highest

grade, "A", was assigned by Sweden. Eight countries assigned an "INC" grade for this indicator. With an "A-", Australia was the second most successful country for this indicator. In the Australia's 2018 Report Card, parent-report data showed that most of youth were not faced with problematic traffic in their home or school neighborhood, had access to good roads and footpaths and to public transport in their neighborhood, had a park or playground near their home, and lived in a safe neighborhood.[98] In Taiwan, where this indicator was graded "B+", 81% of 13- to 17-year-olds felt that there were sufficient exercise facilities in their neighbourhood, and they reported spending an average of 9.7 min to reach their primary exercise facilities.[99] The lack of correlation between this indicator and the Overall Physical Activity is aligned with some of the research available on access to facilities.[92] Community and the Built Environment. In accordance with previous Global Matrices,[37,39] the available evidence from this indicator may suggest that the characteristics of the built environment potentially influencing the physical activity of children are already meeting the criteria to be considered favorable in the very high HDI countries. This indicates that having favorable environmental infrastructure alone is not sufficient to promote physical activity in very high HDI countries. Social factors such as family, home, school, and community are also important to promote physical activity among children and youth.

Government

The average grade for the Government indicator was "C+", and the grades ranged from "A" (Slovenia) to "D" (Australia, Guernsey, Jersey, and South Korea). Five countries assigned an "INC" grade to this indicator. With the exception of the four countries with a "D", all the other very high HDI countries obtained a favorable grade ("C" or higher) for the Government indicator. Despite the recommended benchmark for this indicator, Government grades were informed by different types of data in different countries. For example, in Wales, 21 policy documents assessed across different sectors including Health, Sport, Education, Environment, Transport, and Urban Design/Planning were evaluated using the *Health-Enhancing Physical Activity Policy Audit Tool*, obtaining a final score of 54% that was converted to a

letter grade of "C+".[100] In some other countries that did not have relevant quantitative data, a letter grade was graded primarily based on expert opinion. Although most countries reported government physical activity strategies and policies, the absence of a relationship between the Government grades and the Overall Physical Activity grades and the mostly low behavioral grades suggest that these actions are not singularly effective at increasing the prevalence of MVPA among children and youth.

Integrated Discussion

Generally, higher grades were reported for the source of influence indicators in comparison with the behavioral indicators among the 30 very high HDI countries integrated in this study. The average grade for the behavioral indicators was "D+" (ranging from "B-" to "D-") while the average grade for the sources of influence indicators was "C+" (ranging from "A" to "D"). This finding is consistent with previous Global Matrices,[37,39] and may be partially explained by the fact that more than half of the countries that participated in the Global Matrix 1.0 and 2.0 belonged to the very high HDI category.

Japan, the Netherlands, and Slovenia had the highest behavioral score, while Estonia, Chile and the United Arab Emirates had the lowest score (Figure 3). This score was calculated based on the grades for five indicators, and most of the countries had four to five letter grades to inform the score, with the exception of the United Arab Emirates with only two letter grades, and Qatar, Jersey, and Japan with only three letter grades. The amount of "INC" grades for these four countries questions the accuracy of their ranking, in particular for Japan, in the leading position. For the sources of influence score, Slovenia, Denmark, and Finland led the ranking, while the United States, South Korea, and Guernsey ranked at the bottom (Figure 4). While the calculation of the source of influence score was based on the letter grades for four indicators, eight countries had only two letter grades to inform this score, and Guernsey, the Netherlands and Spain had only one. The amount of "INC" grades challenges the correctness of this classification, in particular for the three countries with only one source of influence indicator graded. The

651 comparison of these groups of indicators suggests that the adequate to good grades observed for the
652 source of influence indicators are not translated in good behavioral grades for the very high HDI
653 countries.

654 In total, 24 countries had three or less "INC" grades, but six countries were missing data to grade four to
655 six indicators. Including countries with a significantly large number of "INC" grades in the Global Matrix
656 3.0 is a limitation to this study as it limits the comparisons. For example, the United Arab Emirates had
657 six "INC" grades,[101] Guernsey had five "INC" grades,[102] and Qatar had four "INC" grades, and a "not
658 applicable" for Active Transportation.[46]Another major limitation of this study is the diversity of the data
659 that were used to inform the 10 core indicators, challenging the comparativeness of the grades within the
660 same indicator. Two identical grades for the same indicator can potentially reflect very different situations
661 from one country to another. An alternative approach would have been to exclude the countries with
662 insufficient data from the Global Matrix 3.0, and to have assigned "INC" grades to all the countries with
663 data that were not fitting exactly with the benchmarks for each indicator. Yet, this strategy would have
664 considerably reduced the number of countries and indicators included in the analyses of this study and
665 decrease the relevance of conducting international comparisons within an HDI category. Finally, a loss of
666 information potentially occurs when translating original data to a letter grade, as letter grades provide less
667 information than continuous variables.

668 The main strength of this study is the large number of participating countries who adopted the harmonized
669 data gathering, assessing, and grading process and the quantity of data that are informing the international
670 physical activity comparisons. This was possible as a result of the inclusive strategy adopted by AHKGA.
671 This project offers the opportunity to paint a picture of the characteristics of childhood physical activity in
672 each country, as determined and explained by a diverse group of experts within each country. In addition,
673 despite the presented methodological issues, this study allows the identification of major trends
674 concerning the characteristics of the physical activity of children and youth among very high HDI
675 countries. The need for the development and the international adoption of standardized methods to

676 conceptualise and measure the ten indicators was also highlighted in this paper. An "INC" grade can be
677 useful for advocacy in individual countries in future cards, and the Global Matrix project has the potential
678 to influence the physical activity national surveillance systems in the short to long term. Finally, as
679 demonstrated in the study presenting the international impact of the Report Cards and Global Matrices
680 published in this special issue,[103] the development of a national Report Card of physical activity for
681 children and youth, and the participation in the Global Matrix initiative, contributes to raising awareness
682 on the childhood physical inactivity issue nationally and internationally, building capacity within
683 participating countries, and potentially influencing the creation of physical activity opportunities in the
684 future.

685

686 **Conclusion**

687 This analysis and comparison of the Global Matrix 3.0 grades provide a comprehensive summary of the
688 level and context of the physical activity of children and youth among the participating very high HDI
689 countries. While methodological limitations and research gaps were identified, this work allowed the
690 portrayal of major trends across the 10 physical activity indicators. The majority of very high HDI
691 countries had better grades on the sources of influence levels, but this was not translated in positive
692 outcomes concerning childhood physical activity and sedentary behavior, indicating an implementation
693 gap between the policy/governmental and individual level. This paper provides additional evidence that
694 the situation regarding physical activity in children and youth living in very high HDI countries is
695 extremely concerning. Strategic public investments to implement effective interventions within families,
696 communities, and schools to increase physical activity opportunities are needed. Unless a major shift to a
697 more active lifestyle happens soon, a high rate of non-communicable diseases can be anticipated when
698 this generation of children will reach adulthood.

699

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1022 **Table 1: Global Matrix 3.0 indicators and benchmarks used to guide the grade assignment process**

Indicator	Benchmark
Overall Physical Activity	% of children and youth who meet the Global Recommendations on Physical Activity for Health, which recommend that children and youth accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity per day on average. Or % of children and youth meeting the guidelines on at least 4 days a week (when an average cannot be estimated).
Organized Sport and Physical Activity	% of children and youth who participate in organized sport and/or physical activity programs.
Active Play	% of children and youth who engage in unstructured/unorganized active play at any intensity for more than 2 hours a day. % of children and youth who report being outdoors for more than 2 hours a day.
Active Transportation	% of children and youth who use active transportation to get to and from places (e.g., school, park, mall, friend's house).
Sedentary Behaviors	% of children and youth who meet the Canadian Sedentary Behaviour Guidelines (5- to 17-year-olds: no more than 2 hours of recreational screen time per day). Note: the Guidelines currently provide a time limit recommendation for screen-related pursuits, but not for non-screen-related pursuits.
Physical Fitness	Average percentile achieved on certain physical fitness indicators based on the normative values published by Tomkinson et al.[56]
Family and Peers	% of family members (e.g., parents, guardians) who facilitate physical activity and sport opportunities for their children (e.g., volunteering, coaching, driving, paying for membership fees and equipment). % of parents who meet the Global Recommendations on Physical Activity for Health, which recommend that adults accumulate at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity physical activity. % of family members (e.g., parents, guardians) who are physically active with their kids. % of children and youth with friends and peers who encourage and support them to be physically active. % of children and youth who encourage and support their friends and peers to be physically active.

School	% of schools with active school policies (e.g., daily PE, daily physical activity, recess, "everyone plays" approach, bike racks at school, traffic calming on school property, outdoor time). % of schools where the majority (≥ 80%) of students are taught by a PE specialist. % of schools where the majority (≥ 80%) of students are offered the mandated amount of PE (for the given state/territory/region/country). % of schools that offer physical activity opportunities (excluding PE) to the majority (> 80%) of their students. % of parents who report their children and youth have access to physical activity opportunities at school in addition to PE classes. % of schools with students who have regular access to facilities and equipment that support physical activity (e.g., gymnasium, outdoor playgrounds, sporting fields, multi-purpose space for physical activity, equipment in good condition).
Community and the Built Environment	% of children or parents who perceive their community/municipality is doing a good job at promoting physical activity (e.g., variety, location, cost, quality). % of communities/municipalities that report they have policies promoting physical activity. % of communities/municipalities that report they have infrastructure (e.g., sidewalks, trails, paths, bike lanes) specifically geared toward promoting physical activity. % of children or parents who report having facilities, programs, parks and playgrounds available to them in their community. % of children or parents who report living in a safe neighbourhood where they can be physically active. % of children or parents who report having well-maintained facilities, parks and playgrounds in their community that are safe to use.
Government	Evidence of leadership and commitment in providing physical activity opportunities for all children and youth. Allocated funds and resources for the implementation of physical activity promotion strategies and initiatives for all children and youth. Demonstrated progress through the key stages of public policy making (i.e., policy agenda, policy formation, policy implementation, policy evaluation and decisions about the future).

Table 2: Global Matrix 3.0 grading rubric

Grade	Interpretation	Corresponding number for analysis
A+	94% - 100%	15
A	We are succeeding with a large majority of children and youth (87% - 93%)	14
A-	80% - 86%	13
B+	74% - 79%	12
B	We are succeeding with well over half of children and youth (67% - 73%)	11
B-	60% - 66%	10
C+	54% - 59%	9
C	We are succeeding with about half of children and youth (47% - 53%)	8
C-	40% - 46%	7
D+	34% - 39%	6
D	We are succeeding with less than half but some children and youth (27% - 33%)	5
D-	20% - 26%	4
F	We are succeeding with very few children and youth (<20%)	2
INC	Incomplete - insufficient or inadequate information to assign a grade	No Grade

1040 **Table 3: Sociodemographic information of the 30 very high HDI countries in the Global Matrix 3.0**

Country	HDI[a]	GNI per capita[a]	Public Health Expenditure (% of GDP)[a]	Gender Inequality Index (GII)[a]	Life expectancy at birth[a]	Mean years of schooling[a]	Gini index[b]	Global Food Security Index[c]	Child Poverty Rate[d]	Urban Population Percentage[e]	Population Density (people/ km^2)[f]
Australia	0.939	42822	6.3	0.12	82.5	13.2	34.7	83.3	0.13	89.4	3
Belgium	0.896	41243	8.3	0.073	81	11.4	27.7	79.8	0.11	97.5	374
Canada	0.92	42582	7.4	0.098	82.2	13.1	34	82.2	0.171	80.8	4
Chile	0.847	21665	3.9	0.322	82	9.9	47.7	74.7	0.225	89.4	24
Czech Republic	0.878	28144	6.3	0.129	78.8	12.3	25.9	75.8	0.105	73.4	137
Denmark	0.925	44519	9.2	0.041	80.4	12.7	28.2	80.3	0.029	87.1	136
England	0.909	37931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271
Estonia	0.865	26362	5	0.131	77	12.5	32.7		0.121	69.5	31
Finland	0.895	38868	7.3	0.056	81	11.2	27.1	81	0.037	83.8	18
France	0.897	38085	9	0.102	82.4	11.6	32.7	82.3	0.113	86.4	122
Germany	0.926	45000	8.7	0.066	81.1	13.2	31.7	82.5	0.095	74.1	236
Guernsey*	0.975				82.6		40				850
Hong Kong	0.917	54265			84.2	11.6				100	6987
Japan	0.903	37268	8.6	0.116	83.7	12.5	32.1	79.5		91.9	348
Jersey**	0.985				81.9		41				845
Lithuania	0.848	26006	4.4	0.121	73.5	12.7	37.4		0.191	67.2	46
Netherlands	0.924	46326	9.5	0.044	81.7	11.9	29.3	82.8	0.102	83.6	506
New Zealand	0.915	32870	9.1	0.158	82	12.5		81	0.141	86.3	18
Poland	0.855	24117	4.5	0.137	77.6	11.9	31.8	74.1	0.134	60.8	124
Portugal	0.843	26104	6.2	0.091	81.2	8.9	35.5	79	0.155	61.6	113
Qatar	0.856	129916	1.9	0.542	78.3	9.8		73.3		98.9	221
Scotland	0.909	37931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271
Slovenia	0.89	28664	6.6	0.053	80.6	12.1	25.4			49.8	103
South Korea	0.901	34541	4	0.067	82.1	12.2	31.6		0.071	83.5	526
Spain	0.884	32779	6.4	0.081	82.8	9.8	36.2	78.1	0.221	77.6	93
Sweden	0.913	46251	10	0.048	82.3	12.3	29.2	81.7	0.091	85.4	24
Taiwan***	0.885	45582			80.2		33.6				
United Arab Emirates	0.84	66203	2.6	0.232	77.1	9.5		70.9		84.7	111
United States	0.92	53245	8.3	0.203	79.2	13.2	41.5	84.6	0.199	82.6	35
Wales	0.909	37931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271

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Note: HDI = Human Development Index, GNI = Gross National Income, GDP = Gross Domestic Product, GII = Gender Inequality Index. Sources of information: a., United Nations Development Programme;[8] b. and f., the World Bank;[104,105] c., the Economist Intelligence Unit;[106] d., the Organisation for Economic Co-operation and Development Child (OECD) Well-Being Data Portal;[107] and e., United Nations, Department of Economic and Social Affairs.[108] * For Guernsey, the HDI sourced from the United Nations Economic and Social Commission for Asia and the Pacific,[109] the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency,[110] and the Gini index sourced from the State of Guernsey.[111] **For Jersey, the HDI sourced from[109], the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency,[110] and the Gini index sourced from the State of Jersey.[112] ***For Taiwan, the HDI, the GNI per Capita, the life expectancy at birth and the Gini index come from the National Statistics, Republic of China (Taiwan).[113] For England, Scotland, and Wales, the official data for UK were reported.

Table 4: Grades assigned to the 10 core physical activity indicators for the 30 very high HDI countries of the Global Matrix 3.0

	PA	SP	AP	AT	SB	PF	FAM	SCH	COM	GOV	AVG
Australia	D-	B-	INC	D+	D-	D+	C+	B+	A-	D	C-
Belgium (Flanders)	F	B	INC	C+	C	INC	C+	B-	B	B	C
Canada	D+	B+	D	D-	D+	D	C+	B-	B+	C+	C-
Chile	D-	D-	INC	F	C-	D	F	D	B	B-	D
Czech Republic	D	B-	D-	C+	D-	C+	C+	B+	B	C+	C
Denmark	D-	A-	INC	B+	D+	INC	INC	A-	B+	A-	B-
England	C-	D+	INC	C-	D+	C-	INC	B+	C	INC	C-
Estonia	D-	C	F	D	F	INC	D	C+	B	B	D+
Finland	D	C+	C	B+	D-	C	B-	A	B+	A-	C+
France	D	C-	INC	C-	D-	B-	INC	B	INC	C	C-
Germany	D-	B	D-	C-	D-	INC	B-	B+	B+	INC	C
Guernsey	D	C+	INC	D	C	INC	INC	INC	INC	D	D+
Hong Kong	C-	C	INC	B+	C-	D	D-	C	B	C	C-
Japan	INC	B-	INC	A-	C-	A	C-	B+	B-	B	B-
Jersey	D-	INC	INC	D+	C	D	C	B-	C	D	D+
Lithuania	C-	C	INC	C-	C-	C+	D	C+	C	C	C-
Netherlands	C	B	B	B-	C-	INC	INC	C	INC	INC	C+
New Zealand	D-	B	C+	C-	D	INC	C	B-	B	B+	C
Poland	D-	D	INC	C	D	C-	C-	B	C	C+	C-
Portugal	D	B-	INC	C-	C-	C	C	A	B	B	C+
Qatar	D	D+	INC	N/A	D+	INC	INC	C	INC	B+	C-
Scotland	F	B	INC	C	F	INC	INC	INC	B-	C	D+
Slovenia	A-	C+	D	C	B+	A-	B+	A	B	A	B

South Korea	F	C	INC	B+	D	D+	INC	D+	INC	D	D+
Spain	D	B	C-	B-	B+	INC	INC	C+	INC	INC	C+
Sweden	D+	B+	INC	C	C+	INC	INC	C+	A	B	C+
Taiwan	F	D-	INC	C-	C-	B-	INC	B+	B+	B+	C
United Arab Emirates	F	INC	INC	INC	C-	INC	INC	D-	INC	B+	D+
United States	D-	C	INC	D-	D	C-	INC	D-	C	INC	D
Wales	D+	C+	C-	D+	F	INC	D	INC	INC	C+	D+

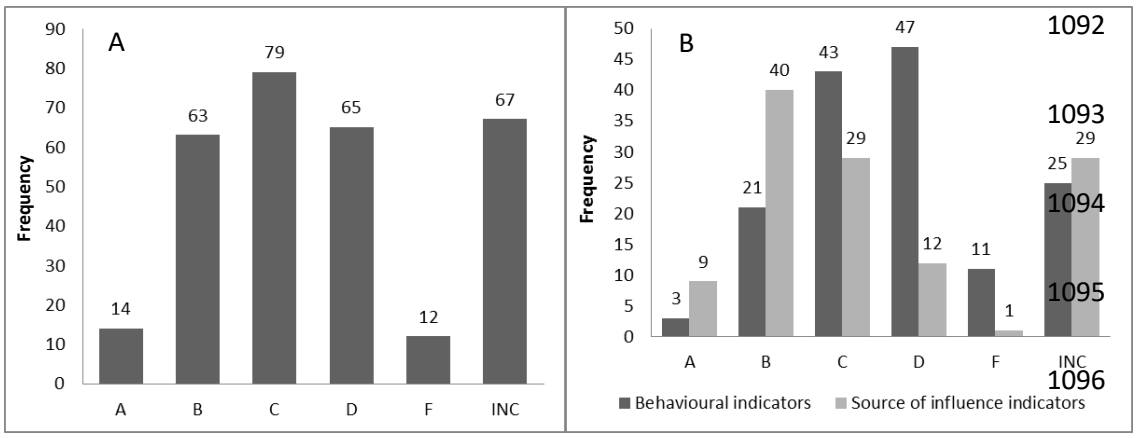
Note: PA = Physical Activity, SP = Organized Sport and Physical Activity Participation, AP = Active Play, AT = Active Transportation, SB = Sedentary Behaviors, PF = Physical Fitness, FAM = Family and Peers, SCH = School, COM = Community and the Built Environment, GOV = Government, AVG = Average, INC = incomplete grade, and N/A = not applicable.

Table 5: Descriptive statistics of the grades by indicator and group of indicators for the very high HDI countries of the Global Matrix 3.0

	Grade count	Incomplete grades	Mean number grade	SD	Mean letter grade	Range
Overall physical activity	29	1	4.9	2.2	D-	F to A-
Organized sport and physical activity participation	28	2	9	2.4	C+	D- to A-
Active play	10	20	6.2	2.7	D+	F to B
Active transportation	28	2	7.8	2.7	C-	F to A-
Sedentary behaviors	30	0	6.1	2.4	D+	F to B+
Physical fitness	17	13	7.9	2.7	C-	D to A
Family and peers	17	13	7.5	2.6	C-	F to B+
School	27	3	9.9	2.9	C+	D- to A
Community and the Built Environment	22	8	10.7	1.7	B-	C to A
Government	25	5	9.6	2.7	C+	D to A
Behavioral indicators	30	0	6.8	1.6	D+	D- to B-
Sources of influence indicators	30	0	9.3	2	C+	D to A-
All indicators	30	0	7.9	1.5	C-	D+ to B

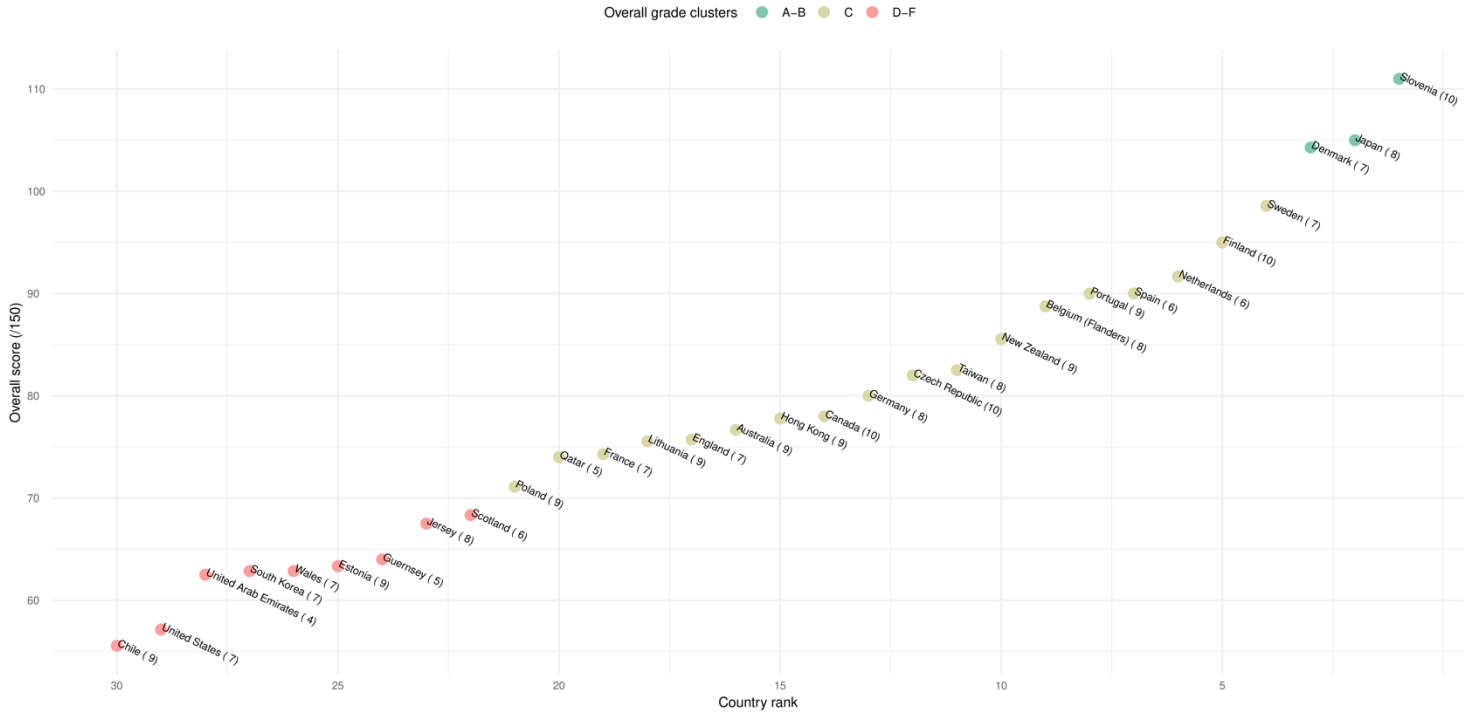
Note: Behavioral indicators = Average of Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behavior indicator grades; Source of influence indicators = Average of Family and Peers, School, Community and the Built Environment, and Government Strategies and Investments indicator grades. Physical fitness was not included in the behavioral indicators cluster. There are no missing grades for the bottom three rows because these scores are adjusted for missing grades.

Figure 1: Frequency plot by letter grade among 30 very high-HDI countries in the Global Matrix 3.0. A: For the 10 core indicators. B: For the behavioral indicators and for the source of influence indicators.



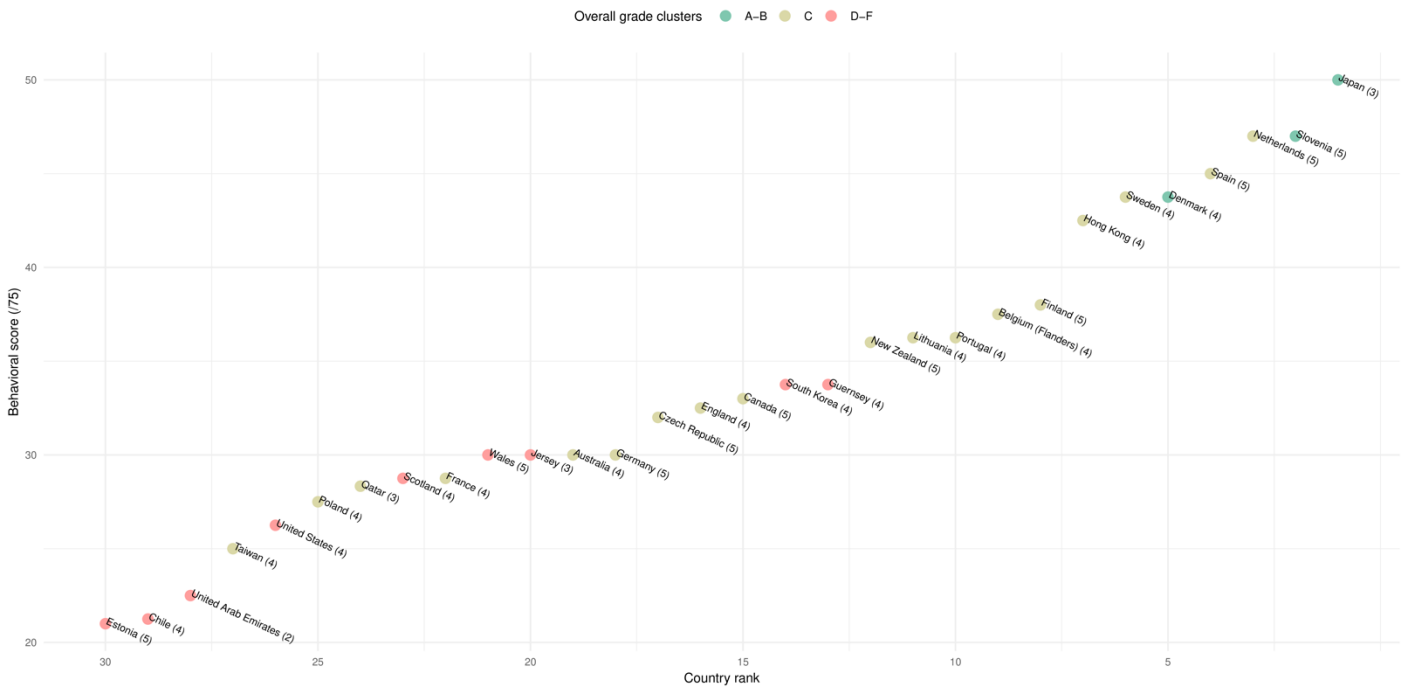
Note: Behavioral indicators = Average of Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behavior indicator grades; Source of influence indicators = Average of Family and Peers, School, Community and the Built Environment, and Government Strategies and Investments indicator grades. Physical fitness was not included in the behavioral indicators cluster.

Figure 2: Plot of the overall score estimated for the 10 core indicators for the 30 very high HDI countries of the Global Matrix 3.0



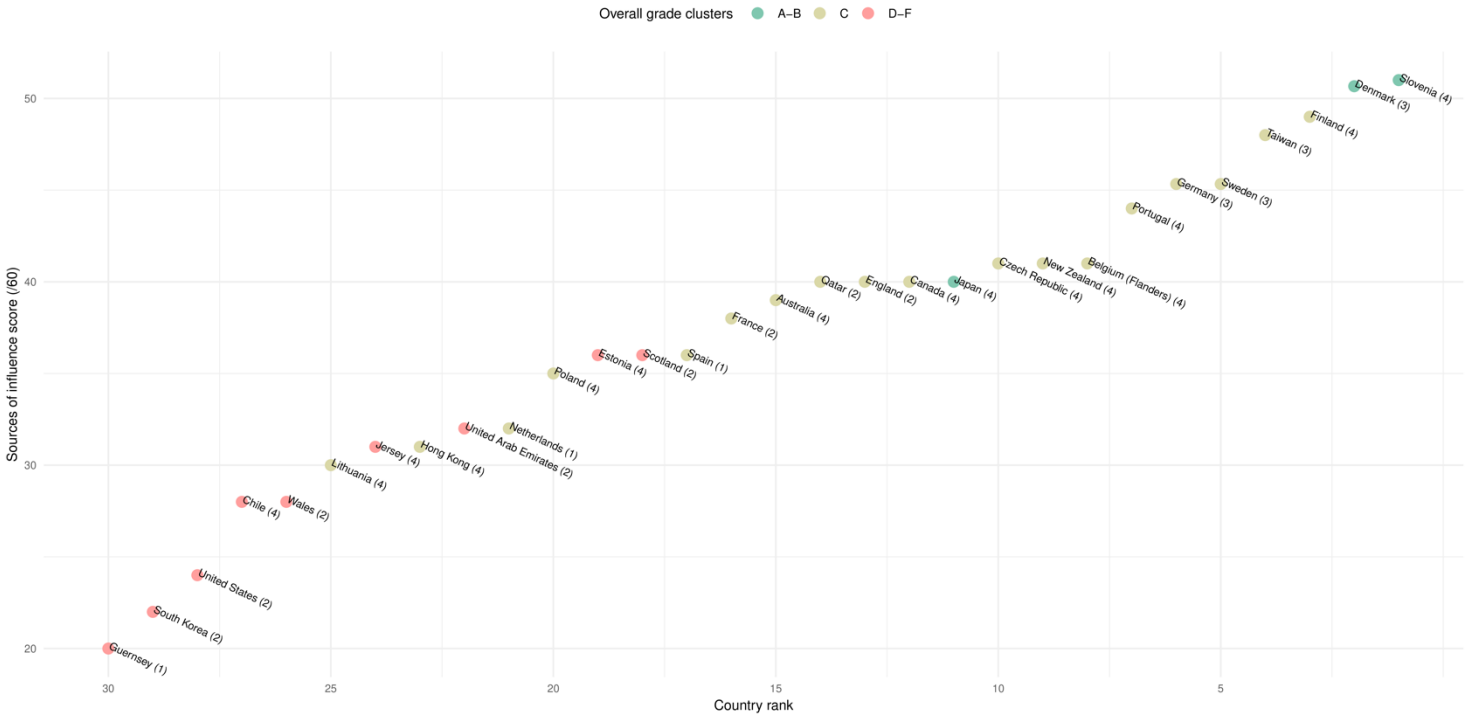
Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score.

Figure 3: Plot of the behavioral score estimated for the very high HDI countries of the Global Matrix 3.0



Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score.

Figure 4: Plot of the source of influence indicators score for the very high HDI countries of the Global Matrix 3.0



Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score. These estimates of sources of influence score are interpreted with a high degree of caution as they are likely imprecise estimates of sources of influence due to the level of missing data used to determine this score.